NEBULAR AND INTERSTELLAR MATERIALS IN A GIANT CLUSTER IDP OF PROBABLE COMETARY ORIGIN.

S. Messenger[1], D. E. Brownlee[2], D. J. Joswiak[2], and A.N. Nguyen[3] [1]Robert M Walker Laboratory for Space Science, EISD, ARES, NASA Johnson Space Center, Houston TX scott.r.messenger@nasa.gov [2]University of Washington, Dept. of Astronomy, Seattle WA, [3]JETS, NASA Johnson Space Center, Houston TX.

Introduction: Comets contain a complex mixture of materials with presolar and Solar System origins [1, 2]. Chondritic porous interplanetary dust particles (CP-IDPs) are associated with comets by their fragile nature, unequilibrated anhydrous mineralogy and high abundances of circumstellar grains and isotopically anomalous organic materials [1]. Comet 81P/Wild 2 samples returned by the Stardust spacecraft contain presolar materials as well as refractory ^{16}O-rich Ca-Al-rich inclusion- (CAI), chondrule-, and AOA-like materials [2-5]. We are conducting coordinated chemical, mineralogical, and isotopic studies of a giant cluster CP-IDP (U2-20-GCA) to determine the proportions of inner Solar System and interstellar materials. We previously found that this IDP contains abundant presolar silicates (~1,800 ppm) and ^{15}N-rich hotspots [6].

Experimental: Sub-μm fines from the IDP are concentrated, washed of silicone oil and embedded in epoxy for ultramicrotomy. Alternating series of sections are deposited on TEM grids for mineralogical study and on Au substrates for isotopic measurements. A series of O and N isotopic images of two 20 x 60 μm sections containing hundreds of μm and sub-μm grains were obtained with the JSC NanoSIMS 50L ion microprobe.

Results & Discussion: The grains in these sections have typical mineralogy of CP-IDPs, including crystalline and amorphous silicates, sulfides, and an enstatite whisker. No presolar grains with large O isotopic anomalies were found in these new samples. However, μm-sized grains with δ^{15}N of 500-1000 ‰ are common. One ^{16}O-rich grain was identified, with δ^{17}O = -40 ± 9, δ^{18}O = -44 ± 4 ‰, similar to CAIs and the Sun. Comparison of the NanoSIMS images with TEM images of adjacent sections indicates that the ^{16}O-rich grain is a 1 x 2 μm enstatite crystal. The enstatite is Mg rich (En_{99}), with 0.5 wt% Fe, 0.4 wt% Cr, and 0.1 wt% Mn. The mineralogy and O isotopic composition of the enstatite is consistent with a condensation origin near the Sun early in Solar System history. This IDP also contains larger moderately refractory Al-rich chondrules, AOAs, possible CAI fragments and augite grains with high Cr and Na [7-9]. Inner Solar System, ^{16}O-rich phases appear to be more abundant than presolar grains in this IDP and comet Wild-2 samples. Further studies of cometary IDPs and returned comet samples are needed to determine whether presolar and ^{16}O-rich inner Solar System materials occur in consistent proportions among comets.

References: [1] Messenger S. et al. (2014) in: *Dust in the Solar System: Properties and Origins*. [2] Brownlee D. E. *et al.* (2006) *Science* 314, 1711 [3] Joswiak D. J. et al. (2014) *GCA* 144, 277. [4] Matzel J. E. P. et al. (2010) *Science* 328, 483. [5] McKeegan K. D. et al. (2006) *Science* 314, 1724 [6] Messenger S. et al. (2015) *LPS* 46, #2603 [7] Brownlee D. E. et al. (2011) *LPS* 42, #2235 [8] Joswiak D. J. & Brownlee D. E. (2014) *LPS* 45, #2282 [9] Joswiak D. J. et al. (2013) *LPS* 44, #2410.